

CURRICULUM VITAE

PROFESSOR, PH.D. ERIK LUND, AUGUST 2008

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PRIVATE ADDRESS

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PERSONAL DETAILS

Date of birth: January 25th, 1967, in Haderup
Private status: Married, two children
Citizenship: Danish

PROFESSIONAL FIELD

Interests Mechanical Engineering, in particular Design Optimization, Finite Element Methods, Composite Structures, Fluid-Structure Interaction Problems, Design Sensitivity Analysis.

DEGREES

1986 Artium, Math.-phys, Holstebro Gymnasium.
1991 M.Sc. (civ.ing.) in Mechanical Engineering, Aalborg University (AAU).
1994 Ph.D. in Mechanical Engineering, AAU.

POSITIONS

1991-1994 Ph.D. student at the Institute (now Department) of Mechanical Engineering (IME), AAU.
1994 Research Assistant, IME, AAU (August - October 1994).
1994-1997 Assistant Professor at IME, AAU.
1997-2007 Associate Professor at IME, AAU.
2007- Professor with special duties in Computational Mechanics and Design Optimization at IME, AAU.

RESEARCH PROJECTS

1991-1997 Partly employee and participant, STVF Programme of Research on Computer Aided Engineering Design.
1994-1995 Partly employee and participant, EU-STRIDE Project "Rational Design and Optimization".
1998-2002 Director of the STVF talent project "Interdisciplinary Analysis and Design Optimization of Systems with Fluid-Structure Interaction" (funded by the Danish Technical Research Council).
2002-2005 Leader of three projects in "Center for Machine Acoustics".
2003-2005 Collaborator, EFP project "Improved Basis for Design of Large Wind Turbine Blades (Phase 2)".
2005-2007 Collaborator, EFP project "Improved Basis for Design of Large Wind Turbine Blades (Phase 3)".
2007-2010 Director of the FTP project "Multi-Material Design Optimization of Composite Structures" (funded by the Danish Research Council for Technology and Production Sciences).

HONORS AND AWARDS

The ISSMO/Springer Prize 2001 for a Young Scientist.
"Teacher of the Year" (Årets Underviser) at the Industry and Global Business Development (M) Study Board, AAU (elected by students) in 1998, 2003 and 2006.

MAIN RESEARCH INTERESTS

Most of my research has been devoted to computer aided analysis and design optimization of structures and multidisciplinary problems, in particular:

- Development of general computer aided tools for finite element analysis and design optimization. I am one of the main developers of the Optimum DESign SYstem ODESSY in the period 1991–1998, and since then the research platform has been MUST - the MULTidisciplinary Synthesis Tool. Most of my Ph.D. students have been involved in the development of MUST.
- "Exact" semi-analytical design sensitivity analysis for elimination of inaccuracies related to finite difference approximations in sensitivity computations.
- Design sensitivity analysis and optimization algorithms for multiple eigenvalues in structural problems, such that the problems of having non-differentiable eigenvalues are taken into account.

- Analysis and multi-disciplinary gradient based design optimization of coupled problems, in particular strongly coupled fluid-structure interaction problems.
- Collaboration with danish manufacturers of wind turbine blades, mostly related to structural analysis and optimization.
- Analysis and gradient based design optimization of laminated composite structures, e.g. wind turbine blades. Topology optimization approaches, introducing the so-called Discrete Material Optimization method where the combinatorial problem of proper choice of material and fiber orientation is solved simultaneously, have been developed.

PH.D. STUDENTS

Formerly advisor for six Ph.D. students (see their theses on my personal homepage) and three Post.docs.
Currently advisor for five Ph.D. students.

The Ph.D. students are:

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| 1998-2002 | Henrik Møller: Analysis and Optimization for Fluid-Structure Interaction Problems. |
| 1999-2002 | Lars Aaes Jakobsen: A Finite Element Approach to Analysis and Sensitivity Analysis of Time Dependent Fluid-Structure Interaction Systems. |
| 1999-2003 | Michael S. Koefoed: Modeling, Simulation and Optimization of the VARTM process for Wind Turbine Blades (industrial Ph.D. project, LM Glasfiber A/S). |
| 2001-2004 | Jan Stegmann: Analysis and Optimization of Laminated Composite Shell Structures. |
| 2001-2005 | Jens Chr. Rauhe: Finite Element Method for Analysis of Material Properties (co-supervisor with Prof. Ryszard Pyrz, AAU) |
| 2002-2006 | Lennart Kühlmeier: Buckling of Wind Turbine Rotor Blades - Analysis, Design and Experimental Validation (industrial Ph.D. project, Vestas Wind Systems A/S, co-supervisor with Prof. Ole Thybo Thomsen, AAU) |
| 2004-2007 | Lars Christian Terndrup Overgaard: Structural Instability Phenomena in Wind Turbine Blades (co-supervisor with Prof. Ole Thybo Thomsen, AAU). |
| 2005-2008 | Leon Johansen: Analysis and Optimization of Composite Structures Using Adaptive Analysis Methods |
| 2006-2009 | Anders Libak Hansen: Hierarchical FEM for Wind Turbine Blades |
| 2007-2010 | Christian Gram Hvejsel: Multi-Material Design Optimization of Composite Structures |
| 2007-2010 | Esben Lindgaard Olesen: Buckling Optimization of Composite Structures |

OTHER TEACHING EXPERIENCES

Advisor for 28 Master theses and a large number of other student theses at IME, AAU.

I have taught nine different courses at Masters level on finite element methods, numerical methods, advanced analysis methods and structural mechanics under the Mechanical Engineering (M) Study Board and the Civil Engineering (B) Study Board, AAU.

Lecturer at the Ph.D. course "Analysis and Design Optimisation of Laminated Composite Structures" held at IME, AAU, May-June 2004, May-June 2006, and May 2008.

Lecturer and organizer of the Ph.D. course "Advanced Optimization" held at IME, AAU, April-May 2005 and April-May 2007.

BOARDS AND ACADEMIC SERVICE

Chairman of the board of WEST - Wind Energy Systems and Technologies. A center for wind power research and education at AAU (2002-2006).

Member of the Scientific Council of DCAMM - Danish Center for Applied Mathematics and Mechanics (2006-).

Member of the Executive Committee of NoACM - the Nordic Association for Computational Mechanics (2006-).

Invited "Key panel speaker" at the 6th World Congress on Structural and Multidisciplinary Optimization, May 30 - June 3, Rio de Janeiro, Brasil, 2005.

Invited "Key note speaker" at the 8th World Congress on Computational Mechanics (WCCM8), June 30 - July 5, 2008, Venice, Italy.

Numerous invited talks and chairman at international conferences, national workshops, and advanced graduate courses.

Opponent for 4 Ph.D. theses at AAU, 3 at the Technical University of Denmark and 1 at Linköping University, Sweden.

Member of the Industry and Global Business Development (M) Study Board, AAU (1999-2000 and 2002-).

Contact person for the Masters programme (M.Sc. Curricula) "Design of Mechanical Systems", Industry and Global Business Development (M) Study Board, AAU.

2002-2006: Member of the board of Ewald Winds Understøttelsesfond.

Lecturer at "Dansk Naturvidenskabsfestival 2002, 2004, 2006, 2007 and 2008" (totally 20 lectures at different High Schools).

Examiner of master courses and master theses at the Technical University of Denmark and Southern University of Denmark.

Co-chairman of the 15th Nordic Seminar on Computational Mechanics, 18-19 October, 2002, Aalborg, Denmark.

Member of the Local Organizing Committee, 7th International Conference on Sandwich Structures, Aalborg, Denmark, 29-31 August 2005.

Member of the committee appointed for the preparation of revised and modernized curriculum for the B.Sc. and M.Sc. Curricula in Mechanical Engineering at the Institute of Mechanical Engineering, AAU (since 2000).

Ad hoc reviewer for scientific international journals (Journal of Structural and Multidisciplinary Optimization, International Journal of Solids and Structures, Journal of Optimization and Engineering, Finite Elements in Analysis and Design, Journal of Fluids and Structures, ASME Mechanical Design Journal, Journal of Sandwich Structures, Journal of Composite Structures, Journal of Mechanics of Materials and Structures, Computers & Structures, and International Journal for Numerical Methods in Engineering).

PUBLICATIONS SINCE 2005

Has totally published 17 papers in reviewed international journals and 64 papers in proceedings and monographs with peer review, besides a number of other articles, reports and abstracts from conferences without proceedings. Editor of 1 conference proceedings. More than 130 unique citations at ISI Web of Knowledge (august 2006). Complete list of publications can be found on personal homepage.

Articles in Refereed International Journals:

- [1] Johansen, L.S.; Lund, E. (2008): "Optimization of Laminated Composite Structures Using Delamination Criteria and Hierarchical Models", *Structural and Multidisciplinary Optimization*, available online: doi:10.1007/s00158-008-0280-1.
- [2] Lund, E. (2008): "Buckling Topology Optimization of Laminated Multi-Material Composite Shell Structures". *Journal of Composite Structures*, accepted.
- [3] Klemensø, T.; Lund, E.; Sørensen, B. (2007): "Optimal Shape of Thin Tensile Test Specimen". *Journal of the American Ceramic Society*, Vol. 90, No. 6, pp. 1827-1835
- [4] Stegmann, J.; Lund, E. (2005): "Discrete Material Optimization of General Composite Shell Structures". *International Journal for Numerical Methods in Engineering*, Vol. 62, No. 14, pp. 2009-2027.
- [5] Lund, E.; Stegmann, J. (2005): "On Structural Optimization of Composite Shell Structures Using A Discrete Constitutive Parameterization". *Wind Energy*, Vol. 8, Issue 1, pp. 109-124.
- [6] Møller, H.; Lund, E.; Ambrósio, J.; Gonçalves, J. (2005): "Simulation of Fluid Loaded Flexible Multiple Bodies". *Multibody System Dynamics*, Vol. 13, No. 1, pp. 113-128.
- [7] Bendsøe, M.P.; Lund, E.; Olhoff, N.; Sigmund, O. (2005): "Topology Optimization - Broadening the Areas of Application". *Control and Cybernetics*, Vol. 34, No. 1, pp. 7-35.
- [8] Stegmann, J.; Lund, E. (2005): Nonlinear Topology Optimization of Layered Shell Structures. *Structural and Multidisciplinary Optimization*, Vol. 29, pp. 349-360.

Articles in Proceedings and Monographs with Review:

- [9] Lund, E.; Johansen, L.S. (2008): "On Buckling Optimization of a Wind Turbine Blade", in *Mechanical Response of Composites, Computational Methods in Applied Sciences*, Vol. 10 (Eds. P. Camanho et al), Springer, ISBN 978-1-4020-8583-3.
- [10] Lund, E. (2007): "Multi-Material Buckling Topology Optimization of Laminated Structures with Stiffness Constraints". In: *Proc. 7th World Congress on Structural and Multidisciplinary Optimization*, 21 - 25 May 2007, Seoul, Korea, CD-ROM, ISBN 978-89-959384-2-3-98550, 10 pages.
- [11] Johansen, L.S.; Lund, E. (2007): "Optimization of Geometrically Linear/Nonlinear Laminated Composites Through Delamination Criterion and Model Adaptivity". In: *Proc. 7th World Congress on Structural and Multidisciplinary Optimization*, 21 - 25 May 2007, Seoul, Korea, CD-ROM, ISBN 978-89-959384-2-3-98550, 10 pages.
- [12] Lund, E. (2006): "Buckling Topology Optimization of Laminated Multi-Material Composite Structures". In: *Proc. 8th Biennial ASME Conference on Engineering Systems Design and Analysis, ESDA 2006*, Torino, Italy, July 4-7, 2006, ASME paper ESDA2006-95753, 10 pages, ISBN 0-7918-3779-3, ASME.
- [13] Lund, E. (2006): "Large Scale Optimization of Compression Loaded Composite Structures". In: *Proc. III European Conference on Computational Mechanics Solids, Structures and Coupled Problems in Engineering* (Eds. C.A. Mota Soares et al), Lisbon, Portugal, 5-8 June, 2006, 20 pages.

- [14] Johansen, L.S.; Lund, E. (2006): "Optimization of Laminated Composite Structures Using Delamination Criteria and Adaptive Models". In: *Proc. III European Conference on Computational Mechanics Solids, Structures and Coupled Problems in Engineering* (Eds. C.A. Mota Soares et al), Lisbon, Portugal, 5–8 June, 2006, 19 pages.
- [15] Lund, E.; Stegmann, J. (2006): "Eigenfrequency and Buckling Optimization of Laminated Composite Shell Structures Using Discrete Material Optimization. In: *IUTUAM Symposium on Topological Design Optimization of Structures, Machines and Materials: Status and Perspectives* (eds. M.P. Bendsøe, N. Olhoff and O. Sigmund), pp. 147-156, Springer.
- [16] Stegmann, J.; Lund, E. (2006): "On Discrete Material Optimization of Laminated Composites Using Global and Local Criteria. In: *IUTUAM Symposium on Topological Design Optimization of Structures, Machines and Materials: Status and Perspectives* (eds. M.P. Bendsøe, N. Olhoff and O. Sigmund), pp. 89-98, Springer.
- [17] Jakobsen, J.; Johansen, L.S.; Lund, E.; Thomsen, O.T. (2005): "Shape Optimisation of Core Interfaces in Sandwich Structures". In: *Proc. 18th Nordic Seminar on Computational Mechanics, NSCM18*, (eds. J. Paavola and J. Freund), 27-30 October 2005, Helsinki, Finland, pp. 157.160.
- [18] Stegmann, J.; Lund, E. (2005): "Designing Sandwich Inserts and Core Junctions for Maximum Structural Stiffness using Discrete Material Optimization". In: *Proc. 7th International Conference on Sandwich Structures, ICSS7* (Eds. O. T. Thomsen, E. Bozhevolnaya and A. Lyckegaard), 29-31 August 2005, Aalborg, Denmark, ISBN 1-4020-3444-XX, pp. 351-361.
- [19] Lund, E.; Stegmann, J.; Johansen, L.; Jakobsen, J. (2005): On Methods for Gradient Based Structural Optimization of Sandwich Structures. In: *Theory and Applications of Sandwich Structures* (Eds. R. A. Shenoi, A. Groves & Y. D. S. Rajapakse), University of Southampton, ISBN 085432-8254, pp. 287-322.
- [20] Lund, E.; Stegmann, J. (2005): "Eigenfrequency Optimization of General Composite Shell Structures Using a Discrete Material Optimization Approach". In: *Proc. 12th International Congress on Sound and Vibration*, 11 - 14 July, Lisbon, Portugal, CD-ROM, 8 pages.
- [21] Kühlmeier, L.; Thomsen, O.T.; Lund, E. (2005): "Large Scale Buckling Experiment and Validation of Predictive Capabilities". In: *Proc. 15th International Conference on Composite Materials*, 27 June - 1 July, Durban, South Africa, CD-ROM, 10 pages.
- [22] Lund, E.; Kühlmeier, L.; Stegmann, J. (2005): "Buckling Optimization of Laminated Hybrid Composite Shell Structures Using Discrete Material Optimization". In: *Proc. Sixth World Congress on Structural and Multidisciplinary Optimization* (Eds. J. Herskovits, S. Matorche and A. Canelas), Rio de Janeiro, 30 May - 03 June 2005, Brazil, CD-ROM, ISBN 85-285-0070-5, 10 pages.
- [23] Overgaard, L.C.T.; Lund, E. (2005): "Structural Design Sensitivity Analysis and Optimization of Vestas V52 Wind Turbine Blade". In: *Proc. WCSMO6 - 6th World Congress on Structural and Multidisciplinary Optimization* (Eds. J. Herskovits, S. Matorche og A. Canelas), 30 May - 3 June 2005, Rio de Janeiro, Brasil, CD-ROM, ISBN: 85-285-0070-5, 10 pages.
- [24] Stegmann, J.; Lund, E. (2005): "Discrete Material Optimization of Laminated Composite Shell Structures Using Local Strain Criteria". In: *Proc. WCSMO6 - 6th World Congress on Structural and Multidisciplinary Optimization* (Eds. J. Herskovits, S. Matorche og A. Canelas), 30 May - 3 June 2005, Rio de Janeiro, Brasil, CD-ROM, ISBN: 85-285-0070-5, 10 pages.